Chapter 6: Non-Water Quality Impacts

INTRODUCTION

This chapter discusses side effects of the operation of recirculating wet cooling towers including increased air emissions due to energy penalties, vapor plumes, noise, salt or mineral drift, water consumption through evaporation, and solid waste generation due to wastewater treatment of tower blowdown.

6.1 AIR EMISSIONS INCREASES

Due to recirculating wet cooling system energy penalties, as described in Chapter 5, EPA estimates that air emissions may marginally increase from power plants that retrofit from once-through to recirculating wet cooling systems. The energy penalties reduce the efficiency of the electricity generation process and increase auxiliary power consumption; thereby increasing the quantity of fuel consumed per unit of electricity generated. EPA assumes facilities will seek to compensate for the energy penalties and maintain their electricity generation levels because of contractual obligations and market conditions. EPA believes the facilities will be capable of compensating for the energy penalties based on its analysis of unused capacity in the industry. EPA presents the estimates of annual air emissions increases under the flow reduction-waterbody option (Option 1) in Table 6-1 below. This analysis describes estimated increases only for Option 1.

EPA developed estimates of incremental increases in air emissions of carbon dioxide (CO_2), mercury (Hg), sulfur dioxide (SO_2), nitrogen oxides (NOx), and particulate matter (PM2.5 and PM10) for the facilities projected to upgrade their cooling systems under the flow reduction-waterbody option in today's proposed rule. These facilities include nuclear, combined-cycle, and fossil fuel-fired power plants. Generally, combined-cycle plants produce significantly less air emissions per kilowatt-hour of electricity generated than fossil fuel-fired plants. Because a combined-cycle plant requires cooling for approximately one-third of its process (on a megawatt capacity basis) and because of the differences in combustion products from natural gas versus other fossil fuels, the combined-cycle plant produces less air emissions than fossil fuel-fired plants, even after such plants are equipped with state-of-the-art emissions controls. Nuclear power plants utilize radioactive materials as fuel and have extremely low or negligible emission rates of CO_2, Hg, SO_2, NOx, PM2.5, and PM10 in comparison to those found at either combined-cycle or fossil fuel-fired facilities.

EPA assumed that a facility incurring an energy penalty from retrofitting a once-through cooling system to a recirculating wet cooling system would seek to compensate for that penalty by increasing their electricity generation and would be able to do so by increasing electricity generation on-site. Most facilities do not operate at full electricity generation capacity on an annual basis. EPA believes such facilities would be able to compensate on an annual basis for the annual energy penalty due to conversion to a recirculating wet cooling system by increasing on-site electricity generation.

EPA could alternatively assume that plants incurring an energy penalty will not increase their fuel consumption on-site to overcome incurred energy penalties. Instead, facilities affected by the requirements of this rule would purchase replacement power from the grid. Under this scenario, the air emissions increases associated with a particular energy penalty at an affected plant would be released by the rest of the grid as a whole, thereby comprising small increases at a large number and variety of power plants. During the development of the Section 316(b) Final Rule addressing new facilities, EPA received comments asserting that not all facilities, especially during times of peak demand, would be able to increase their fuel consumption to overcome energy penalties. Nuclear facilities, in particular, may not be able to increase generation on-site. EPA has not calculated the national marginal increase in air emissions associated with purchase of electricity from the grid, though it notes that such purchases are a possible outcome of cooling system conversions. The Agency believes that the outcome of a national analysis would be similar to that of the facility-specific analysis because the distribution of facility types and their associated emissions profiles in each analysis would be comparable.

The estimated air emissions increases presented in Table 6-x below represent facility-specific increases and are based on the estimated energy penalty for each facility, the facility's historic average electricity generation level, and its average historic emission rates. The data source for the Agency's air emissions estimates of CO_2, SO_2, NO_X, and Hg is the EPA-developed database titled E-GRID 2000. This database is a compendium of reported air emissions, plant characteristics, and industry profiles for the entire US electricity generation industry in the years 1996 through 1998. The database relies on information from power plant emissions reporting data from the Energy Information Administration of the Department of Energy. The database compiles information on every major power plant in the United States and includes statistics such as plant operating capacity, air emissions, electricity generated, fuel consumed, etc. This database provided ample data for the Agency to conduct air emissions increases analyses for this rule. The emissions reported in the database are for the power plants' actual emissions to the atmosphere and represent emissions after the influence of air pollution control devices. To test the veracity of the database for the purposes of this rule, the Agency compared the information to other sources of data available on power plant capacities, fuel-types, locations, owners, and ages. Without exception, the E-GRID 2000 database provided accurate estimates of each of these characteristics versus information that EPA was able to obtain from other sources. E-GRID 2000, however, does not provide information on emissions of particulate matter. The data source for historic emissions rates of PM2.5 and PM10 is the EPA-developed database titled National Emission Trends (NET). The NET database is an emission inventory that contains data on stationary and mobile sources that emit criteria air pollutants and their precursors. The NET is released every three years (e.g., 1996 and 1999) and includes emission estimates for all 50 States, the District of Columbia, Puerto Rico, and the Virgin Islands. The database compiles information from EPA air programs and the Department of Energy, and the information it contains was found to be consistent with the information found in E-GRID 2000.

A facility that increases on-site electricity generation to compensate for the energy penalty associated with retrofitting its cooling water system may, because of the resultant on-site increase in air pollutant emissions, be subject to new source review (NSR). Major stationary sources of air pollution undergoing major modifications are required by the Clean Air Act to obtain an air pollution permit before commencing construction. The process is called new source review and is required whether the major source or modification is planned for an area where the national ambient air quality standards (NAAQS) are exceeded (nonattainment areas) or an area where air quality is acceptable (attainment and unclassifiable areas).

There are costs associated both with undergoing NSR and with measures taken to ensure compliance with new air emission control requirements delineated during the NSR process. If a facility purchases electricity from the grid, it does not need to undergo NSR and can therefore avoid the associated costs. EPA believes that some facilities retrofitting their cooling systems under the proposed regulatory alternative requiring flow reduction commensurate with closed cycle wet cooling based on water body type may choose to purchase energy from the grid rather than incur the costs associated with NSR. The resulting increase in emissions would be similar to that estimated given on-site generation of additional electricity.

However, to provide a conservative estimate of the number of facilities potentially subject to NSR costs under today's proposed Option 1, EPA first assumed all facilities would undergo NSR review before attempting to purchase energy off the grid. To yield a conservative estimate of the number of facilities potentially subject to NSR costs, EPA assumed that all facilities would be operating at full capacity once they had increased electricity generation to compensate for the energy penalty associated with retrofitting their cooling systems. This assumption maximizes the estimated marginal increase in air pollutant emissions associated with energy penalty compensation. This conservative screen indicated that 29 facilities could potentially be subject to NSR costs.

Table 6-1. Estimated Increase in Emissions under Flow Reduction-Waterbody Option*

Facility Code**	Annual CO_2 (tons)	Annual SO_2 (tons)	Annual NO_x (tons)	Annual Hg (lbs)	Annual PM2.5 (tons)	Annual PM10 (tons)
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	15,417	0.1	5.8	-	0.05	0.05
4	17,024	0.1	6.8	-	0.04	0.04
5	17,421	0.1	16.7	-	0.04	0.04
6	14,528	0.1	1.0	-	0.03	0.03
7	22,678	-	18	-	0.06	0.06
8	24,968	0.4	19.2	-	0.06	0.05
9	12,560	0.3	4.7	-	0.02	0.02
10	26,722	0.2	5.1	-	0.09	0.09
11	282,344	1,718.2	695.6	7.1	25.07	11.31
12	130,879	1,217	636	5.5	8.55	4.54
13	232,551	1,923.6	809.4	7.2	27.52	11.23
14	82,957	658.4	229.9	2.7	6.90	3.15
15	142,339	1,103.0	407.6	5.5	12.91	6.36
16	-	-	-	-	-	-
17	-	-	-	-	-	-
18	-	-	-	-	-	-
19	39,928	477.2	168.8	-	4.38	3.91
20	37,846	471	89	-	2.53	2.11
21	71,247	587.4	166.4	-	4.56	3.93
22	40,005	116.5	68.9	-	2.25	1.96
23	20,016	59	31	-	0.98	0.84
24	-	-	-	-	-	-
25	96,279	0.8	154.9	-	0.30	0.30
26	8,330	-	18	-	0.02	0.02
27	70,291	0.6	154.1	-	0.20	0.20

Table 6-1. Estimated Increase in Emissions under Flow Reduction-Waterbody Option*

Facility Code**	Annual CO_2 (tons)	Annual SO_2 (tons)	Annual NO_x (tons)	Annual Hg (lbs)	Annual PM2.5 (tons)	Annual PM10 (tons)
28	39,540	0.3	62.9	-	0.12	0.12
29	29,876	-	49	-	0.08	0.08
30	71,191	552.5	188.0	3.1	4.41	2.00
31	147,288	1,464.5	462.0	6.7	10.26	4.65
32	47,497	209.7	227.3	0.2	1.76	0.97
33	48,034	279.2	159.1	1.8	3.60	1.64
34	2,802	-	0.8	-	-	-
35	-	-	-	-	-	-
36	-	-	-	-	-	-
37	52,664	255	104	1.9	3.07	1.89
38	80,985	461.7	322.2	2.4	18.24	7.91
39	821	-	2	-	0.02	0.01
40	1,626	7	3	-	0.06	0.06
41	1,204	1.4	3.3	-	0.02	0.02
42	3,095	1.0	3.8	-	0.08	0.07
43	15,848	81	26	-	0.56	0.26
44	74,962	549.4	114.9	0.1	9.76	4.96
45	154,087	851.1	264.3	3.8	12.27	5.77
46	116	-	-	-	-	-
47	1,974	-	-	-	-	-
48	32,941	0.7	36.1	-	0.63	0.63
49	66,131	31	74	-	0.70	0.61
50	-	-	-	-	-	-
51	-	-	-	-	-	-
52	-	-	-	-	-	-
53	76,207	290.2	79.6	-	0.11	0.09
54	41,229	263.9	52.7	-	2.95	2.60
55	22,708	98.9	27.9	-	1.15	0.99
56	56,147	242	75	-	3.87	2.04
57	-	-	-	-	-	-
58	50,286	291.2	67.0	-	3.05	2.71
59	7	-	-	-	-	-

Dashes indicate negligible emissions increases.
*This table includes information from those facilities with capacity utilization rates below 15% .
**EPA developed model plants representing existing facilities for analyzing regulatory options and developing costs. To protect confidential business information, EPA has assigned these model plants a random code number.

6.2 Vapor Plumes

Natural draft or mechanical draft cooling towers can produce vapor plumes. Plumes can create problems for fogging and icing, which have been recorded to create dangerous conditions for local roads and for air and water navigation. Plumes are in some cases disfavored for reasons of aesthetics. Generally, mechanical draft cooling towers have significantly shorter plumes than those for natural draft towers (by approximately 30 percent).

As discussed in Chapter 4, the Agency considered regulatory options based on flow reduction commensurate with closed-cycle wet cooling systems. The Department of Energy (DOE) expressed concern to the Agency that plume abatement technologies would be required for a subset of existing plants projected to adopt wet cooling towers under these options. The DOE believed that the options based on flow reduction should consider a significant portion of existing facilities converting from once-through systems to hybrid wet/dry cooling towers, instead of the wet (only) towers examined by the Agency.

Historically, plants have adopted plume reduction technologies for the following reasons: visual aesthetics,[1] liability relating to icing and fogging of nearby transportation routes (US EPA Reg I, 2002), and potentially elevated moisture levels affected nearby agriculture. For the 316(b) New Facility Final Rule, the Agency considered plume effects of wet cooling towers. The Agency determined that for the limited number of new, "greenfield" facilities that may adopt towers to meet the flow reduction requirements of the rule,[2] that the plume effects would not be a sufficient environmental concern, especially in comparison to the significant aquatic environmental benefits of intake flow reduction.[3] However, in the Agency's view, the issue of vapor plume effects at existing facilities requires a slightly different consideration. Existing facilities do not have the advantage of siting and designing the plant layout to minimize plume effects, which is far and away the most economic means of plume mitigation. Through the utilization of terrain features, buffer areas, prevailing wind directions, and site selection, the new, "greenfield" facility has a set of tools that provide a distinct advantage for plume mitigation over an existing plant converting its cooling system. Therefore, the Agency examined historic studies and example cases of plumes and plume mitigation to understand the prevalence and necessity of plume abatement for cooling tower installations at existing facilities.

Hybrid wet/dry tower systems are the technology most frequently associated with plume abatement. The primary type of wet/dry tower employed in practice is a configuration where an air-cooled condensing unit sits atop a wet evaporative unit. This technology, in effect, reduces the amount of moisture transferred to the air by raising the temperature and lowering the relative humidity of the exhaust air. The heated water from the condensers is fed first to the top, dry portion of the tower, where air flows around the air-cooled condenser and heat transfers to the environment without evaporation of water. The water then disperses through the wet portion of the system, where heat transfer from the water to the air occurs primarily through the more efficient means of evaporation. Because the air-cooled portion creates an elevated temperature environment for the exhaust plume and reduces the temperature of the water before entering the evaporative section, the frequency and extent of the exhaust vapor plume is reduced. The air-cooled portion of the hybrid-wet/dry tower is relatively inefficient in comparison to the wet-cooled system,

[1] November 2001, "Hearing Report and Recommended Decision by State of New York, in the Matter of Mirant Bowline, LLC, Application for a State Pollutant Discharge Elimination System." The report states, "Mirant has explained that the primary reason for revising the cooling/intake proposal is to reduce cooling tower steam plumes, thereby further reducing adverse visual impacts of the project."

[2] Note: the 316(b) New Facility Rule estimated that nine-new, "greenfield" facilities over a twenty year period would comply with the rule by installing wet cooling towers. However, the New Facility rule did not mandate a compliance technology and provides flexible compliance options through a multi-track framework.

[3] Chapter 3 of the Technical Development Document of the Final Regulations Addressing Cooling Water Intake Structures for New Facilities.

and the overall efficiency of the hybrid system is reduced compared to a wet (only) cooling tower. However, advances in the design of the hybrid tower systems allow bypassing of the air-cooled condenser portion, thereby allowing the tower to function in the more efficient wet (only) cooling mode when the meteorological conditions do not favor visual plume formation or electricity demand requires maximum capacity of the plant (BDT Engineering, 2000) (US EPA Reg I, 2002). The Agency notes that the type of hybrid tower used for plume abatement generally does not reduce water intake compared to a wet cooling tower and would, therefore, have no appreciable reduction in the potential aquatic impacts of cooling water intakes. In addition, the technology may, through the fact that it is less efficient than a wet (only) cooling tower system, cause the plant to emit more air pollutants due to the energy penalty as compared to a wet cooling tower system and a once-through system.

The ratio of the capital cost of the hybrid tower systems (alone, without the necessary and costly auxiliary components such as piping, pumps, etc.) to the cost of wet (only) towers (without necessary, auxiliary components) generally is on the order of 2.0 to 3.0 (Mirsky, et al., 1992) (Power Tech Associates, 1999). For a typical new facility installation, including all of the auxiliary components of yard piping, pumps and motors, basin, sump, electrical wiring and controls, excavation, site preparation, water treatment, etc., the cooling tower unit will comprise a portion of the total capital costs. The Utility Water Act Group, in comments submitted to the Agency for the 316(b) New Facility Proposed Rule presented wet (only) cooling tower unit costs as approximately 45 percent of the total cooling tower system direct capital costs and approximately 35 percent of total estimated costs (Burns and Michiletti, 2000). Several turnkey costs that the Agency received from cooling tower engineering firms showed the wet cooling tower unit portion of total project costs varied from approximately 25 to 40 percent. The Agency expects that the hybrid wet/dry tower would not appreciably affect the auxiliary component costs of a full cooling tower installation. Therefore, the Agency concludes that hybrid wet/dry tower unit would increase the overall capital costs for the total cooling tower system (including all auxiliary components) at a new, "greenfield" facility by approximately 25 to 80 percent as compared to a wet (only) unit. For cooling systems conversions, the Agency estimates that the cooling tower unit would be identical to that of a new, "greenfield" facility, but that the auxiliary components would be considerably more expensive. The Agency estimates that the overall cooling tower project costs would be roughly 20 percent more expensive, due mostly to the increase in costs of the auxiliary components. Hence, for existing-facility cooling tower retrofits, the Agency estimates the increase in overall project cost for a hybrid wet/dry cooling tower unit over a wet (only) unit would range between 20 and 65 percent.[4]

As stated above, the primary reasons for adopting plume abatement are considerations of visual aesthetics, transportation interference liability, and agricultural interference. The Agency is not aware of a database or a combination of sources of information that identify the prevalence of installations of hybrid wet/dry cooling systems. Approximately 80 of the 539 plants for which the Agency has detailed information employ some form of recirculating cooling system, many of these are cooling towers. The Agency's data collection, unfortunately, did not distinguish between the type of cooling tower in-place at these facilities. However, several other data sources do specify the type of cooling tower in-place for many existing power plants: the Power Statistics Unit Design Data File Part B of the 1994 UDI Database and NUREG-1437, the Generic Environmental Impact Statement prepared by the Nuclear Regulatory Commission. After consulting these two data additional data sources, the Agency was unable to specifically identify any of the 539 plants that utilize hybrid wet/dry towers. The Agency, however, did learn from one of the world's largest cooling tower vendors that roughly 3 to 5 percent of their recent installations utilize plume abatement. This figure alone does not form adequate basis for deciding the necessity of plume abatement, which can only truly be gauged by detailed meteorological studies at each site. In order to gauge the prevalence of cooling towers and their proximity to transportation corridors, the Agency examined a significant portion of the facilities

[4] Power Tech Associates (1999) state, when referring to their estimates of cooling system conversion costs for the four Hudson River plants, "the effect of using wet/dry towers is much less than a 25 percent increase in the overall conversion costs."

within the scope of this rule that have closed cycle systems in-place in cold climates (that is, any climate deemed to have periods each year with predictable freezing and icing). The Agency mapped as many of these plants as possible and examined their proximity to highways, navigable rivers and lakes, and railways. The Agency identified 16 facilities with full-recirculating cooling systems and very large megawatt (steam) capacities that were within close proximity (that is, several meters to several hundred meters) to major highways, navigable rivers and lakes, and railways. Only one of these facilities (Bergen Generating Station) utilizes a form of plume abatement, to the Agency's knowledge. The other plants – Keystone Generating Station (PA), Conemaugh Generating Station (PA), Trojan Nuclear (OR, now retired and decommissioning), Michigan City Station (IN), Sherbourne County Station (MN), General J M Gavin (OH), Mill Creek Units 2 & 3 (KY), Cardinal Unit 3 (OH), W H Zimmer (OH), Ghent Station (KY), Rockport Station (IN), Big Sandy (KY), Muskingum River (OH), John E Amos (WV), and Muskogee Station (OK) – utilize either natural draft or mechanical draft wet (only) towers (US EPA, 2002).

In addition to the examples above, the Agency examined the US Capitol Power Plant (DC) and Pawtucket Power (RI). Although the US Capitol Power Plant operates a small, 7-cell mechanical-draft wet (only) cooling tower system, the proximity of the cooling tower and plume to an elevated interstate and many of the United States primary landmarks is striking. The thirty-foot tall cooling tower system frequently projects a vapor plume that extends across and into several lanes of traffic along one of the nation's busiest interstates, an elevated highway. The Pawtucket Power Station near Providence is another small plant situated adjacent to a major highway. The mechanical draft cooling towers of this 70-MW plant produce plumes in the winter in New England that the Agency observed migrating across I-95 and several stories high. The Agency considers these examples of wet cooling towers in close proximity to transportation routes and in cold climates as examples of a relatively pervasive practice.

The Agency contacted Bergen Station regarding their cooling tower system, which is within 700 feet of the New Jersey Turnpike (and nearby to a bridge on the same road). Bergen Station conducted a study of the possible plume impacts to the interstate. The model (a SACTI model) projected a 1-hour impact within a 5-year period. The station mitigated this risk by installing a hybrid-wet/dry cooling system that employs several cells of wet (only) units. The plant has the capability to switch between wet and dry modes and operates under the hybrid mode during the winter and, on occasion, during humid days in the spring for aesthetic reasons (US EPA Reg. I, 2002).

The Agency also consulted the detailed historical study conducted by four Hudson River steam-electric plants (Central Hudson Gas & Electric, 1977). The report examined the environmental and economic impacts from the potential installation and operation of natural-draft wet (only) cooling towers at Bowline Point, Indian Point 2 and 3, and Roseton Generating Stations along the Hudson River in New York. The calculation of multi-plant induced fog and icing impacts from the potential operation of 4 large natural-draft wet cooling towers was, "not expected to be substantial." The Agency notes that this analysis focused on the operation of natural-draft wet cooling towers, which have significantly larger and taller plumes than mechanical-draft wet cooling towers (the modern basis for the vast majority of new cooling tower construction in the United States). Therefore, the effects of potential mechanical-draft units would be even less than those studied.

Considering the evidence that it collected, the Agency determined that it should examine the sensitivity of compliance costs for certain regulatory options based on the installation of plume abatement technologies at a small portion of facilities expected to retrofit their cooling systems. Therefore, the Agency examined the sensitivity of the overall national costs of regulatory option 1 (that is, the option based on flow reduction and installation of closed-cycle cooling systems at approximately 53 facilities) to plume abatement installation costs at 3 facilities (that is, 6 percent of 53). The overall impact on the annual compliance costs for regulatory option 1 was an increase of approximately 2 percent. This is based on the calculation of increased cooling system retrofit capital costs as discussed above (that is, a conservative 65 percent increase of overall project-capital costs for three plants with compliance costs centered about the median) and O&M increases as estimated by the operation multiplier factors recommended in literature (Mirsky, et al., 1992). If as many as 6 facilities out of 53 (that is, a 3 fold increase over the percentage estimated by the reputable tower supplier) would adopt plume abatement installation costs, the impact on the option's annual compliance costs would be approximately a 4 percent increase. Based on the evidence gathered by the Agency, installation of plume abatement at more than 10 percent of the facilities projected to convert cooling systems as a result of regulatory option 1 would not be probable.

6.3 Displacement of Wetlands or Other Land Habitats

Mechanical draft cooling towers can require land areas (footprints) approaching 1.5 acres for the average sized new cooling tower projected for this rule. The land requirements of mechanical draft wet cooling towers do not approach the size of the campus. In consideration of displacement of wetlands or other land and habitat due to the moderate plant size increases due to cooling tower installations at nine facilities, the Agency determined that existing 404 programs would more than adequately protect wetlands and habitats for these modest land uses. In addition, the displacement of wetlands on an industrial site such as a large existing power plant is not a probable outcome of cooling tower construction, in the Agency's opinion.

6.4 Salt or Mineral Drift

The operation of cooling towers using either brackish water or salt water can release water droplets containing soluble salts, including sodium, calcium, chloride, and sulfate ions. Additionally, salt drift may occur at fresh water systems that operate recirculating cooling water systems at very high cycles of concentration. Salt drift from such towers may be carried by prevailing winds and settle onto soil, vegetation, and waterbodies. The DOE expressed concern to the Agency that salt drift may be problematic for the types of plants potentially subject to the regulatory option 1. This could cause damage to crops through deposition directly on the plants or accumulation of salts in the soil. The cooling tower system design and the salt content of the source water are the primary factors affecting the amount of salt emitted as drift. In addition, modern cooling towers utilize inexpensive drift reducing technologies (called drift eliminators) that have been developed to minimize salt or mineral drift effects.

In the cases where it is necessary, salt drift effects (if any) may also be mitigated by additional means that are similar to those used to minimize migrating vapor plumes (that is, through acquisition of buffer land area surrounding the tower). Additionally, modern cooling towers are designed as to minimize drift through the use of drift elimination technologies. The Agency has considered the capital costs for the abatement of drift for all model plants projected to install cooling towers through regulatory option 1. The approximate change in total annual compliance costs for this option would be less than 1 percent. High efficiency drift eliminators, which reduce drift by an order of magnitude, increase the capital cost of a cooling tower unit (which, as in the case of plume abatement above, is a portion of the total project costs for a retrofit cooling system) by approximately 4 percent and the fan brake horsepower by a similar margin (Mirsky, et al., 1992). These increases, as evidenced by the approximate analysis conducted by the Agency, show very minimal cost impacts on regulatory Option 1.

NUREG-1437 states the following concerning salt/mineral drift from cooling towers: "generally, drift from cooling towers using fresh water has low salt concentrations and, in the case of mechanical draft towers, falls mostly within the immediate vicinity of the towers, representing little hazard to vegetation off-site. Typical amounts of salt or total dissolved solids in freshwater environments are around 1000 ppm (ANL/ES-53)." The conclusions reached in NUREG about salt-drift upon extensive study at existing nuclear plants: "monitoring results from the sample of [eighteen] nuclear plants and from the coal-fired Chalk Point plant, in conjunction with the literature review and information provided by the natural resource agencies and agricultural agencies in all states with nuclear power plants, have revealed no instances where cooling tower operation has resulted in measurable productivity losses in agricultural crops or measurable damage to ornamental vegetation. Because ongoing operational conditions of cooling towers would remain unchanged, it is expected that there would continue to be no measurable impacts on crops or ornamental vegetation as a result of license renewal. The impact of cooling towers on agricultural crops and ornamental vegetation will therefore be of small significance. Because there is no measurable impact, there is no need to consider mitigation. Cumulative impacts on crops and ornamental vegetation are not a consideration because deposition from cooling tower drift is a localized phenomenon and because of the distance between nuclear power plant sites and other facilities that may have large cooling towers."

The historical study conducted by Central Hudson, et al. (1977) examined the economic and environmental impacts of drift from the four estuarine power plants along the Hudson – Bowline Point, Indian Point 2 and 3, and Roseton Generating Station – for proposed natural draft cooling tower systems. The analysis found the total economic impact from drift damage to vegetation to range from $226,000 to $654,000 (sum present worth - 1977 $). In the Agency's view, these economic impacts are relatively small in comparison to the quantified benefits of entrainment reduction.

6.5 Noise

Noise from mechanical draft cooling towers is generated by falling water inside the towers plus fan or motor noise or both. However, power plant sites generally do not result in off-site levels more than 10 dB(A) above background (NUREG-1437 Vol. 1). Noise abatement features are an integral and inexpensive component of modern cooling tower designs (See Appendix B, Charts 2-1 through 2-6 for a comparison of low-noise tower costs and other types of tower modifiers). The cost contribution of low noise fans would comprise a very small portion of the total installed capital cost of a retrofitted cooling system (on the same order as drift elimination technologies). As such, the Agency is confident that the issue of noise abatement is not critical to the evaluation of the environmental side-effects of cooling towers. In addition, this issue is primarily in terms of adverse public reactions to the noise and not environmental or human health (i.e., hearing) impacts. The NRC adds further, "Natural-draft and mechanical-draft cooling towers emit noise of a broadband nature...Because of the broadband character of the cooling towers, the noise associated with them is largely indistinguishable and less obtrusive than transformer noise or loudspeaker noise."

6.6 Solid Waste Generation

For cooling towers, recirculation of cooling water increases solid wastes generated because some facilities treat the cooling tower blowdown in a wastewater treatment system, and the concentrated pollutants removed from the blowdown add to the amount of wastewater sludge generated by the facility. For facilities operating cooling towers with brackish or saline waters, the concentration of salts within the tower and blowdown are a primary design factor. As such, these systems can have elevated salt concentrations over most freshwater sources. However, the concentration of salts is a treatable condition for blowdown from towers. The costing model adopted by the Agency for the capital and O&M costs of cooling towers accounts for the treatment of tower blow-down (see Chapter 2). The increase in solids wastes would be a manageable problem for option 1, where approximately 53 cooling towers would be installed under the considered option. However, for all 539 facilities (a ten fold increase) the issue of solids waste disposal may take on a greater concern to the Agency.

6.7 Evaporative Consumption of Water

Cooling tower operation is designed to result in a measurable evaporation of water drawn from the source water. Depending on the size and flow conditions of the affected waterbody, evaporative water loss can affect the quality of aquatic habitat and recreational fishing. Once-through cooling consumes water, in and of itself. According to NUREG-1437, "water lost by evaporation from the heated discharge of once-through cooling is about 60 percent of that which is lost through cooling towers." NUREG-1437 goes on to further state, "with once-through cooling systems, evaporative losses...occur externally in the adjacent body of water instead of in the closed-cycle system." Therefore, evaporation does occur due to heating of water in once-through cooling systems, even though the majority of this loss happens down-stream of the plant in the receiving water body. The Agency notes that for option 1, the only cooling towers projected to be installed would be in saline and brackish waters. Competing uses for these waters is not as great a concern as that for freshwater. As such, the Agency did not quantitatively determine water consumption levels for this considered regulatory option. For considered options in which cooling towers were projected in freshwaters, the Agency determined that the option was economically impracticable, and as such, did not complete a quantitative analysis of the consumptive water use of this option.

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